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ULCERS are solutions of continuity produced by internal or external agencies. Their origin lies in a superficially disposed infiltration; the surrounding tissue is cloudy, the overlying epithelial cells desquamate, the diseased portion of the cornea breaks down, and an excavation is formed. This description represents the inception of a corneal ulcer. In addition to the disintegration of the most necrotic area, the cloudiness before mentioned frequently increases, accompanied by advancing tissue destruction. The latter may penetrate deeply, proceed superficially in one or all directions, or may assume a serpiginous character. In the first or progressive stage the boundaries are infiltrated and present a grayish appearance, the edges are jagged, and the base uneven. Assuming a typical case, the exudation is cast off and the neighboring infiltration is absorbed, producing a clean ulcer. The cavity is now larger, but on the other hand it is transparent.

This describes the second or regressive stage of an extremely favorable and, generally speaking, of an asthenic

case. In the third stage, that of cicatrization, the cavity becomes filled with a reparative exudation. Blood-vessels visible to the naked eye may course from the limbus to the ulcer; sometimes these capillaries are so small as to be invisible without the assistance of a magnifying lens; again, they may be absent, and healing takes place through the agency of the lymphatic channels. The newly formed tissue is cicatricial in character; healing is complete when the cavity is filled and the epithelium restored. In clean ulcers it is occasionally observed that the cellular covering dips down into the excavation, so that the normal reflex is obtainable; the cavity then fills up under the epithelium. This somewhat rare condition must be borne in mind. Rather often the ulcer does not completely refill, the cells cover this tissue *in statu quo*, and a facet results; conversely, in other cases the cicatrix protrudes beyond the surface of the cornea. This is due to the intra-ocular pressure against the thinned cornea, producing a keratectasia. Before discussing the untoward results of corneal ulcers, let us consider briefly the histology of inflammation and reparation. Cohnheim advanced the view that the motile cells of Recklinghausen, which are in reality leucocytes, produced the inflammatory phenomena; others, Stricker in particular, maintained that the fixed corneal corpuscles were the agents. I am personally of the opinion that the former is correct. In regard to the reparation of the ulcerative process, the epithelium is formed from that surrounding the excavation, and the connective-tissue growth is an exudation metamorphosis. We are therefore forced to the conclusion that the white blood-cells in physiological proportions are, *cæteris paribus*, necessary adjuvants to healing, while in excessive numbers they become inflammatory factors. The clearing of corneal cicatrices takes place in the following manner: Through some form of metabolism

the new connective tissue disappears and the corneal substance replaces it. The membrane of Bowman is never restored; its absence *per se* does not interfere in any manner whatsoever with vision. The return of the corneal stroma is effected by a caryocinesis of the stellate fixed cells, with their subsequent development. In this manner, in my opinion, do both corneal constituents engage in reparation, while but one produces inflammation. As a result of increasing necrosis, perforation is likely to occur; this casualty may be induced by some violent action on the part of the patient, such as sneezing, coughing, etc. Should the perforation be small and be situated over the iris, the latter will become attached to the posterior part of the opening and incorporate itself in the cicatrix (synechia anterior). If the opening be larger, the iris will protrude and form a cystoid mass (hernia iridis), which by the contraction of the cicatrix will flatten and become denser. A pinhead protrusion is called myiocephalon (*Fliegenkopf*). In severer forms there may occur a total prolapse of the iris. These hernial conditions produce ectatic corneæ and give rise to staphylomata.

Small herniæ recently formed possess the normal iris color; later they present a grayish appearance on account of exudation. When the iris has been rarefied through tension, the retinal pigment causes the prolapse to appear black. Should the pathological opening be situated over the pupil, the iris can not be included; hence the anterior chamber becomes obliterated and the lens lies at the site of the perforation. There is a tendency for the same to close by a new tissue formation which emanates from the edges of the wound. It sometimes happens that this thin membranous growth is ruptured by carelessness on the part of the patient or through internal pressure, and a permanent fistula results; the cornea then flattens, the

globe becomes soft, and the eye is lost from a general disintegration; conversely, it may temporarily close. The lens, from being in contact with the perforation, may, and often does, develop a capsular cataract. Increased tension manifests itself and ruptures the newly formed plug. This alternating condition may persist for some length of time until panophthalmitis supervenes, and is followed by phthisis bulbi. Perforation may be preceded by a hernia of Descemet's membrane (keratocele), which becomes incorporated in the cicatrix, and, as a clear vesicle, is seen projecting above the surface of the cornea surrounded by white scar tissue. Keratocele may also occur independently, however. Among the fortuities dependent upon perforation, I may mention subluxation of the lens and also intra-ocular hæmorrhage. In the former case the passage of the crystalline to the anterior part of the aqueous chamber stretches the zonula and some of the fibers may be lacerated. Should the corneal fenestration be sufficiently large, the lens may be expelled. Hæmorrhage occurs in cases in which perforation takes place suddenly, and where increased tension has previously existed. The sudden removal of pressure permits an increased quantity of blood to enter the vessels, producing rupture of the same. A vascular degeneration has usually pre-existed; both these conditions are regularly present in glaucomatous and staphylo-matous eyes. The hæmorrhage may extrude the ocular contents, and likewise may be so profuse as to imperil the life of the patient.

Concomitant Lesions.—From the beginning of a keratitis, circumcorneal injection is manifest. If the ciliary body be moderately affected, there is seen a pinkish circumcorneal halo. With iritis the congestion is much darker and more intense; very often a marked conjunctival injection coexists. In very severe forms of ulcer there is visible

chemosis of the conjunctiva, and even œdema of the lids. A symptom which has frequently attracted my attention—viz., a dilated pupil and a deep anterior chamber, with but slight inflammatory symptoms and no deposits upon Descemet's endothelium—is a very constant complication of ulcer. The subjective symptoms in mild cases are referable to the corneal lesion; in severer forms there is great pain. I have termed this condition simple serous cyclitis. The tension generally is slightly increased. When iritis is present, in addition to the vascular congestion before mentioned, the pupil is irregular and contracted, the iris dull, often swollen and discolored, and, after a variable period of duration, capsular adhesions are formed. The cornea also becomes hazy and the aqueous turbid.

It is a matter of certainty, established by microscopical examination, that in iritis the ciliary body is likewise involved; but, when the changes in the latter are very slight, they become masked by the iritis. Iridocyclitis is said to exist when, in addition to the iris symptoms, the following are present:

1. Ciliary tenderness.
2. Opacities on the posterior surface of the cornea, and deepening of the filtration angle; the latter, when associated with an immobile pupil, indicates the existence of total posterior synechia.
3. Heightened inflammatory symptoms, with œdema of the upper lid.
4. Great disturbance in vision due to opacities in the vitreous. Tension either plus or minus. (The limitation of space prevents my discussing this part of the subject *in extenso*.)

Hypopyon frequently complicates ulcer; it is derived at times from the cornea, though more often it is of uveal

origin; on the other hand, however, it may arise from both sources. The exudation consists principally of pus-cells and fibrino-plastic material. Microscopically, a line is sometimes seen coursing from the corneal suppuration to the anterior chamber. In the pus, uveal pigment is nearly always found, establishing in these instances its intra-ocular origin. The exudation may be fluid or thick; in the latter state it organizes, and may occlude the pupil. In favorable cases it escapes through the ligamentum pectinatum and the lymph channels. It is a regular accompaniment of *ulcus septicum* or its prototype, abscess of the cornea, and occurs without the existence of suppurative keratitis in many cases of iridocyclitis. The quantity of pus varies; it may be almost imperceptible, or, on the other hand, may fill the anterior chamber.

The following data will enable a correct diagnosis to be made through a facile means of distinction: If the corneal surface is dull without a loss of substance, there is present either an infiltration or an abscess; with a denudation it is a progressive ulcer. If the surface is glistening and the reflex similar to the surrounding normal cornea, we are regarding an old cicatrix. If there is a loss of tissue without the normal reflex, there is a clean ulcer. If the mirrorlike reflex is present, we observe a healed corneal facet, or an ulcer filling under the epithelium. For corroboration, fluoresceine may be employed; a few drops of an alkaline solution will produce a play of colors varying from Nile green to canary yellow. A denuded spot will be pigmented by the fluid; the flow of tears or an application of water will remove this subsequently.

Ulcers are divisible into two great classes—primary and secondary. The former arise in the healthy cornea, and the latter are caused by an inflammation of some neighboring membrane. The vast majority of primary ulcers are

traumatic in character, accepting it in a wide sense. Inverted isolated cilia, trichiasis, entropion, growths on the free border of the lid, calcareous deposits on the conjunctiva, particles of dust in the *cul-de-sac*, eczema of the lid, are all extraneous causes. Malnutrition, with consequent hæmatic changes, frequently acts as an exciting factor. Introduction of bacteria from the mouth constitutes an important causative element. This is particularly true of dispensary patients, in whose oral cavities the bacteria of pyorrhœa alveolaris and carious teeth find excellent culture media.

Of the secondary ulcers, we find that phlyctænular, lacrymal, muco-purulent, diphtheritic, and gonorrhœal conjunctivitis, and trachoma are the great excitants. Suppurative keratitis complicates the exanthemata, and is a direct result of conjunctival inflammation. A corneal abscess, opening anteriorly, constitutes a variety of ulcer. In regard to the causes of suppuration we seek an explanation in bacteria. The principal bacterium of localized pus formation is the staphylococcus, of which there are several distinct forms, among others the pyogenes aureus, citreus, albus, flavus, cereus, etc. In every conjunctivitis we find staphylococci; the virulence of the same depends upon their number and also upon the nutritive fields. With the slightest denudation of the corneal epithelium, these bacteria enter and produce suppuration. Bacilli, after perforating wounds from steel blades, etc., and various forms of fungi—such as the *Aspergillus glaucus*, after an injury by a beard of oats, and an undetermined species of hyphomycetes following a traumatism by a pear—have been discovered in a suppurating cornea. As a result of my own investigations, I have found that the *Spirochæta denticola* and the *Leptothrix buccalis* have likewise produced purulent keratitis and sequelæ. In the vast majority of cases the staphylococcus is the only bacterium

in evidence. The working classes and old people in general suffer to a great extent from dacryocystitis, with its accompanying conjunctivitis, and also with non-lacrymal conjunctival catarrhal inflammations. Thus a cinder or a particle of dust which may lodge on, or rather in, the cornea, permits bacteria in this class of cases to enter, and subsequently an ulcer is formed. These foreign bodies may cause only momentary inconvenience, as a sudden flow of tears will suffice to remove them, if very superficial, and immediately afterward the occurrence is forgotten. Thus can we explain the genesis of many so-called idiopathic ulcers.

During the past three years my attention has been particularly called to certain ulcers which occurred in adults where there had been no antecedent conjunctivitis and no traumatism, as far as the patients—who in this particular citation happened to be more intelligent than the average—could recall. From careful interrogation I obtained the information that they used the Harlem and East Rivers as places for natation, and it at once became evident to me that the *raison d'être* of the infection had been explained. This method of inoculation is not so very uncommon, and when we consider the morphology of sewage excreta, it need not create the least astonishment.

Of the bacteriology of autogenous ulcers—those dependent upon hæmic changes—an analogy can well be drawn between them and acne pustules. Bacteria are to be found in the vascular system, but are innocuous when there are a sufficient number of leucocytes. When phagocytosis can no longer be brought to bear, the pyogenic bacteria manifest their potency by producing suppuration, and the cornea suffers as well as other tissues. In regard to the gross pathology of ulcers, phlyctænulæ of the cornea or phlyctænular keratitis, with their evolution, demand special

study. These elevations average from the size of a pin-head to a millet seed; they are usually of a grayish color, and may be situated on any part of the cornea, but are usually more or less marginal. They are solid bodies and consist of an aggregation of lymphoid cells between Bowman's membrane and the epithelium; the smaller ones are completely absorbed at the end of two or three days. The larger disintegrate in the following manner: A minute denudation appears at the apex of the phlyctænula; this continues to increase until the corneal surface is reached; the epithelium may now become restored without a macula resulting, or the process may continue and an ulcer be formed. It is frequently not until this stage is reached that we see the patient.

I described at the beginning of this essay the course of a *typical* ulcer. As usually seen, however, the picture is different; the stage of progression continues, were we to neglect treatment, until the cornea perforates or sloughs entirely away.

The reparative process is partly indicated by the extension of blood-vessels from the limbus; these are most often found in the superior layers of the epithelium (but may be deeper), their outlet being the ulcer; this heals on one side and advances serpiginously; the vessels continue their progress until in many cases, particularly where there have been several efflorescences, the cornea is covered by this vascular formation. After a cure has been effected they become depleted, but their sheaths can always be seen as faint striæ. This is the so-called vascular fasciculus.

Herpes corneæ (febrilis, or zoster) occasions ulcers through the rupture of the vesicles. They spread superficially, but do not penetrate deeply. The tendency is to produce an arborescent figure, to which condition has been applied the term *keratitis dendritica*.

Ulcus rodens runs a characteristic course. It commences near the margin of the cornea, usually on the superior border; the edges are undermined and heavily infiltrated; the inflammatory symptoms are well marked. The ulcer subsequently cleanses itself, vessels form, and cicatrization commences. Suddenly a relapse occurs, the ulcer extends with a recurrence of symptoms, and ultimately the entire cornea has become cicatricial. This disease occurs principally in adults, and frequently involves both corneae, either simultaneously or successively; perforation is rare. The three forms described have given rise to the designation of serpiginous ulcers. Small marginal ulcerations often occur without ascertainable cause. Ulcers from conjunctivitis are either crescentic or irregularly round; they are usually more or less peripheral. In gonorrhoeal and diphtheritic conjunctival inflammations ulceration generally commences inferiorly and spreads rapidly, most frequently with the sequela of panophthalmitis.

Traumatism furnishes a large variety of ulcers; some are small and superficial, healing rapidly under favorable conditions, and are uniformly situated in the palpebral fissure. Another form is very malignant: the edges and base of the wound are yellow, and hypopyon is regularly present. Their course is isologous with that of abscess—in fact, they are small superficial pus foci which have opened anteriorly; they have been described by different observers as *ulcus serpens*, *ulcus septicum*, and *hypopyon keratitis*. The process advances rapidly and the deeper structures become affected synchronously. The disease is distinctly sthenic in character, and the tendency to perforate is marked. From the appearance and rapid growth of the lesion one would assume a more malignant bacterium to be in evidence; but, as culture tests refute this view, we must conclude that the virulence of the staphylococcus depends

largely upon the soil. An abscess of the cornea is not circumscribed; it is diffuse on account of the arrangement of the corneal stroma, in the interstices of which the pus is to be found. The name *onyx* has been given to an interlamellar pus focus.

A very destructive genus is the "ring ulcer." This consists of a purulent groove surrounding the cornea, with the involvement of the adjacent structures. It often follows a ciliary wound, but may occur without a definite history of traumatism. The condition is absolutely incurable. In glaucomatous and staphylomatous eyes ulcers distinguished by their rapid progress and incurability are seen to occur. The eyes are generally lost through extension of the inflammation. Knowing that the underlying cause is an ocular degeneration, the unfortunate prognosis is readily understood. Old corneal cicatrices frequently necrose, giving rise to the so called atheromatous ulcers; they possess a tendency to recur, and may also perforate. In trichomatous pannus small ulcers arise, which may penetrate deeply or coalesce and form one large crescentic cavity. Besides the many characteristic forms which I have described, excavations occur which vary in size from a needle point to a lentil, the ætiology of which is often very obscure.

In regard to the general symptomatology of ulcer, a variable trio is present—pain, photophobia, and lachrymation. The first is local, referable to the distribution of the superior maxillary division of the trifacial nerve, or may be entirely absent.

Photophobia is in certain cases intense; this bears with greatest emphasis on the phlyctenular keratitis of children; in the central ulcer of trachoma we note the opposite extreme. Lachrymation, in my opinion a most favorable symptom, as it keeps the pathological cavity bathed by the antiseptic tears, is present to a greater or lesser degree in

every instance. These symptoms are not by any means in proportion to the size or severity of the lesion. I have observed the greatest amount of irritation produced by a superficial denudation exposing the subepithelial nerves arising from a child's finger nail abrading the cornea.

When iritis intervenes, the pain, particularly nocturnal, is very severe. Cyclitis, when it occasions increased tension, is also accompanied by pain varying in intensity. Hypopyon should not be confounded with abscess, and when both are present lateral examination of the cornea and anterior chamber should prevent any error from occurring.

The duration of an ulcer depends largely upon the therapeutic measures employed. The object of treatment is to refill the cavity as soon as possible. Local medicinal treatment aims at causing death of the bacteria; it is supposed that the ulcer will then cleanse itself and subsequently heal. Logically and theoretically this is perfectly correct; practically it is the reverse. The treatment, which has been in vogue for a long period of time, consists in applying antiseptics locally; boric acid, iodoform, quinine, pyoctanin, yellow-oxide ointment, aristol, etc.—have all been used. I can not say much in their favor; those which possess any efficacy whatever are either mechanical or chemical irritants, and the non-irritating ones are absolutely useless. In regard to the former, conjunctivitis with its accompanying microbes is the result of their employment, and the ulcer is thereby exposed to reinfection. An ulcer will in time either heal or perforate, and these medicinal agents have less influence on the reparative process than in facilitating the progress of ulceration. No doubt there are a few cases in which calomel, etc., have *apparently* improved the existing conditions. There is not the slightest doubt, however, but that Nature effected the cure despite the medicine.

The treatment *par excellence* is cauterization ; for this purpose we employ the actual cautery, preferably by a platinum probe heated in an alcohol flame, or a saturated solution of carbolic acid by means of a rounded match, using cocaine as a local anæsthetic. In either case light contact only is required, and one application usually suffices. The eye should first be laved with a weak solution of creolin or phenol ; boric acid *ad saturandum* may be substituted. Carbolic acid is applicable, in my opinion, only in large ulcers ; whenever practicable I prefer the actual cautery. The former produces good results, but the surrounding cornea may become hazy for a day or two. Neither nitrate of silver nor bichloride of mercury should ever be applied directly to an ulcerative surface, as metallic deposits may result. (In conjunctivitis when ulcers develop the silver may be discarded, and in exceptional cases, if it is imperatively required, the corneal lesion should be covered by the palpebral conjunctiva and thus protected). Notwithstanding the fact that certain writers hold diametrically opposed views on the subject of silver, my opinion is unalterable. Acetate of lead is a dead letter in modern ophthalmology, and in a well-regulated practice is rarely if ever employed. It does not possess any advantage over the other commonly used agents, and its application is attended with the danger of precipitation. Should there exist any corneal denudation whatsoever, a lead incrustation will invariably take place, which must subsequently be removed surgically.

Curettement has been brought into prominence. The ulcer is cleansed, it is true, but it is in the state in which infection may be introduced, and, secondly, the stimulus to healing is absent. Considerable irritation follows this procedure. When we observe a regressive ulcer our desire is to promote reparation ; for this purpose heat, either by means of hot compresses or with a vaporizer, is called into

requisition; in the majority of cases it is to the cautery that a final successful appeal is made. It is therefore much more reasonable to employ the efficacious method first and at all times. Phlyctenulæ of the conjunctiva and sclero-corneal junction should be cauterized; it is the cleanest and most satisfactory mode of treatment, and if a nebula result therefrom it is of no moment. When on the cornea, their absorption may be hastened and facilitated by heat or gentle massage, a small amount of bichloride vaseline being placed in the *cul-de sac*. When through progressive ulceration the elevation has been destroyed and a corneal excavation of varying size is produced thereby, the appropriate treatment for this condition is required. Every corneal denudation which has destroyed any part of the substantia propria will leave a nebula; cauterization will not enlarge its size. By my emphatic advocacy of this method it must not be assumed that I burn every ulcer; on the contrary, I discriminate most carefully, and thereby exclude about ten cases out of a hundred. Those which are not operated on at first sight are clean, non-infiltrated ones, also asthenic ulcers, epithelial desquamations, recent abrasions, and non infective traumatisms; the latter I judge of by the appearance rather than from the history. The only exception to the foregoing statement is the following: In the event of a foreign body being imbedded in the corneal tissue and surrounded by a zone of infiltration, in this case it suffices to remove the *corpus delicti* and scrape away the detritus. Subsequently if the ulcer does not heal in a satisfactory manner it may become necessary finally to cauterize.

The employment of only mild and conservative treatment in progressive and progressing ulcers is, in my opinion, extremely ill-advised. I do not condemn mild treatment at the start, but when its inefficiency is demonstrated at the expense of the patient's eyes, I consider that the

appropriate measures are imperatively demanded. In order that the best results may be obtained from the cautery, the employment of a mydriatic or the combined use of mydriatic and meiotic, in a large percentage of cases, becomes indispensable. In regard to the use of atropine, be the pupil large or small, it should first be artificially dilated. When evidences of simple serous cyclitis are present (deepened anterior chamber and a dilated pupil) after the primary instillation of atropine, the meiotic may be used. For this alternation the following axiom may prove of service: as much eserine as possible—avoiding the causation of an iritis—and as little atropine as possible, sufficient only to maintain a mobile pupil. Generally speaking, this resolves itself in many cases thus: Assuming that we see the patient during the morning, one drop of atropine (one half per cent. for very young children, for others one per cent.) once; one drop of eserine (one fifth per cent.) noon and evening. Second day—morning atropine, and eserine at midday, evening atropine. Third day—morning atropine, and eserine not to be used that day.

On the fourth day, if there are any objective symptoms of cyclitis, the alternation should be resumed, beginning as on the first day, and be continued until the inflammatory signs dependent upon ciliary involvement are on the wane. It is impossible to accurately lay down the law in this matter of alternation, as the eyes of different persons differ in regard to reaction, and it is only through experience that these agents may be employed with advantage and without danger. The rule described above will, however, be of assistance to those unfamiliar with this practice. The main thing is to observe whether the pupil shows an inclination to respond to light; if it remain contracted and irresponsive eight hours after the employment of the eserine, there is present a most positive indication that

iritis is intervening, and atropine is demanded post-haste. It would show a marked appreciation of the warning if the myotic were now consigned to the shelf for a few days, and then used very cautiously. A few experiences of this kind will render the general practitioner quite expert. I have seen the above-mentioned accident occur in given cases when the attending physician, through lack of experience with this class of diseases, failed to recognize the importance of carefully regarding the mobility of the pupil. By exercising a requisite amount of skill and care this casualty can invariably be avoided. In order to alternate with safety, it is necessary—absolutely so—to see the patient every day. In private practice, twice, and even thrice daily reduce *ad minimum* all fear of intercurrent complications and naturally improve the prognosis *ad optimum*. With this treatment it is not a question of the end justifying the means; on the contrary, although there are dangers attendant upon its use in the hands of an inexperienced and untrained person, it is as nearly infallible as anything can be. Any sthenic ulcer treated otherwise than by the cautery, and, if cyclitis coexists, by the eserine atropine alternation combined therewith, is mismanaged. Be there neither iritis nor cyclitis, atropine in moderation is requisite, not alone for its benign influence on the cornea, but as a prophylactic to prevent the intervention of iris congestion and inflammation. Any person desirous of conscientiously and successfully ministering to these cases should familiarize himself with and master the finesse of the described method, or, in justice to the patients, not jeopardize their eyes. I have employed cauterization in suitable instances with, and in appropriate ones without, the “seesaw” in more than five hundred cases with remarkable success, not only in point of rapidity and certainty of cure, but in painlessness as well. There is practically no reaction whatever, and

from the moment the ulcer is burned, healing, with a rapid disappearance of the inflammatory symptoms, follows.

In speaking of ulcers which are, so to speak, candidates for cure, we must naturally omit such as arise from nerve lesions, keratitis neuroparalytica, keratitis e lagophthalmo, and those from degenerative changes—viz., staphyloma, glaucoma, xerosis, and the like. All others are amenable to the form of management under consideration.

Eserine in ulcers should never be prescribed alone; the same is true of atropine in serous cyclitis. The alternation prevents adhesions from forming, and the meiotic diminishes tension by dilating the vessels. If, when we see the patient for the first time, iritis is raging, atropine is required and eserine may, for the present at least, be disregarded; sometimes, however, the iris inflammation is rapidly cured and the evidences of ciliary congestion are seen, requiring the employment of a meiotic. Iritis is often combated with difficulty; if a one-per-cent. solution is not sufficiently strong to dilate the pupil, a two-per-cent. solution should be used. In children a one-per-cent. instead of a one-half-per-cent. is often necessary; leeches, three to six in number, applied to the temporal portion of the external angular process, greatly facilitate the attempts of the atropine. Diaphoretics—viz., pilocarpine and salicylate of sodium—are often of assistance. Iridectomy is necessitated by exceptionally severe cases only. Moderately ancient clinicians observed that after perforation occurred the ulcer healed more rapidly, and this led to the operation of paracentesis. When eserine fails to relieve pain and diminish tension, and the ulcer continues to spread, this may be employed. This procedure should not be repeated too often.

My readers may possibly have remarked that, in speaking of mydriatics and meiotics, atropine and eserine were

the only two mentioned. The reason is manifest: they are the most satisfactory in the connection in which I have advocated their employment.

It must be understood that one and all of these methods, as described, constitute part of the cauterization treatment; nevertheless, they may, if desired, be used independently. Cases are at times in evidence in which the intra-ocular symptoms so greatly preponderate that the "seesaw" proves of the greatest value at first; later the cautery completes the cure. It is not good policy to cauterize and perform paracentesis at the same *séance*; the existing symptoms must indicate which should precede the other. Moist heat is, in the majority of cases, greatly appreciated by the patient. Hot compresses of saturated solution of boric acid, temperature 107° F., are to be applied for five minutes every half hour during the day for sixteen hours. Should there be much conjunctival secretion, the eyelids must be separated at each lavation and bathed with water. Irritants are applicable only in exceptionally severe cases. Under all circumstances the conjunctiva and the fornices must be carefully irrigated and disinfected several times daily by means of a glass eye-douche (undine) filled with any mild non-precipitating antiseptic. The surgical rule of causal treatment bears with great emphasis upon this class of diseases. Galezowski and Bourgeois lay stress on the causative relation of lacrymal catarrhs in the production of severe autogenous ulcers.

Constitutional medication is imperatively demanded. Besides improving the hygiene and mode of life, a medicinal food—viz., cod-liver oil, preferably emulsified and combined with quinine, strychnine, hypophosphites of calcium, sodium, iron, etc.—should be administered during the cooler months of the year.

Alteratives—such as arsenic, the syrup of the iodide of

iron, citrate of iron and quinine, calomel, and bichloride of mercury in small doses—are likewise indicated.

In old trachoma cases the external canthus is tightened, and the roughened conjunctiva irritates the cornea; a canthotomy or canthoplasty relieves the condition. The former procedure is also applicable in the blepharospasm of children, who suffer so intensely from photophobia in the various forms of keratitis. Trachoma should be treated by any rational method.

In phlyctenular keratitis there is almost invariably an associated dermatitis of the lids and the contiguous integument of the cheeks; there is also an inflammation of the nasal mucous membrane, and the acrid discharge produces excoriations at the orifice of the nostrils, the angles of the mouth, and at whatever site it may reach.

In addition to the ocular treatment, the nose should be kept clean; a solution of sodium chloride (3 j to ʒ viij) is to be poured into the nostrils with a medicine dropper three times a day. For the eczema the ointment of the yellow oxide of mercury (gr. iv to ʒ iv) may be advantageously used.

If an ordinary ulcer without iritis be seen within three days of its inception, the treatment by the cautery, combined with the mydriatic-meiotic alternation, effects a cure in five days—at the utmost seven. The longer an ulcer has existed, the less amenable does it become to treatment.

The imminency of perforation renders the prognosis more serious; nevertheless, I have repeatedly had cases in private practice, in the babies' wards of the Post-graduate Hospital and elsewhere in clinics, in which neglected or badly treated ulceration had exposed Descemet's membrane, and others in which keratocele had been occasioned, and, through the cautious use of the cautery and combined treatment, perforation was avoided and healing resulted. There

exists a marked correlation between the mobility of the iris and the activity of the corneal circulation; so that, when an iritis is present, we can not expect such rapid reparation, and *vice versa*.

The bandage plays an important rôle in the treatment of the disease under consideration; there are two varieties, the protective and the pressure. Let us consider the former. During the periods that applications are not being made, a large, soft handkerchief may be tied diagonally over the head, covering the eye, a layer of cotton being interposed. A muco-purulent discharge, unless great cleanliness prevails, constitutes a deterrent. At all events, the patient must not become too accustomed to the eye remaining closed. As soon as the ulcer is healed, a pair of smoked glasses should be substituted, and these will afford sufficient protection from the sun's rays, etc. Generally speaking, the bandage is of most value when patients are exposed to the elements, etc.; this applies with particular force to the poorer classes. For private patients a dark cloth pad suffices. The room should neither be kept dark nor, on the other hand, extremely light. As children have a tendency to rub their eyes whenever there is any irritation, traumatism may be prevented by wearing a wire protector. The same is true to a lesser degree of adults, particularly at night; an accidental rub may effect considerable and even irreparable damage. I have devised an appliance for this purpose which consists of a ventilated concavo-convex mask made of wire, closely interwoven, resembling somewhat a hair sieve in appearance. There are two sizes, large and small, for adults and children respectively. When photophobia exists, the protector may be lined with any dark material. The former may also be placed over a bandage in cases of thinned cornea; the advantage is manifest.

The pressure bandage is made by applying several

layers of gossypium to the closed eyelids and covering this with the roller. The compression is dependent upon the amount of interposed cotton and also upon the firmness with which the bandage is tied; the indications will be considered later.

The treatment of hypopyon does not materially differ from that of the other forms, except that there the pus and the iritis must be considered. The ulcer should be managed *secundum artem*. The purulent exudation, if scanty, may be absorbed either by the application of heat or the internal administration of sulphide of calcium. In the event of its being larger, or persisting, though small, an infero-corneal incision should be made; if tenacious, the hypopyon may be withdrawn with an iris forceps; if fluid, it escapes of its own accord. Should the ulcer extend, notwithstanding the cauterization, on account of increased tension, with or without the continuation of the hypopyon, we must proceed *à la Saemisch*. This procedure is as follows: Make the puncture and counter-puncture in clear cornea with a narrow-bladed knife, bisecting the ulcer. The anterior chamber may now be freed from the pus. The iris will become adherent to the cornea and healing is likely to result. In treating this disease we must bear in mind the implication of the ciliary body, as well as that of the iris. The prognosis is always more or less grave.

In regard to sequelæ, in general, when perforation is about to occur, be it preceded by a keratocele or not, absolute rest is necessary and a mild pressure bandage should be applied. The intra-ocular tension, if increased, may be diminished by the meiotic mydriatic "seesaw." Paracentesis is also applicable, but in the attempt to pierce the cornea the latter rarefied membrane may rupture. For the relief of intense pain, even with the attendant risk, it is preferable to make a sclero-corneal puncture in healthy

tissue rather than follow the procedure adopted by some operators—viz., to needle the ulcer and evacuate the aqueous. If perforation be inevitable, assistance of that character is not required; and if it can possibly be avoided, our duty is to produce healing in as natural a manner as possible, which does *not* mean incorporating the iris. Should the tension be diminished, atropine alone avails us. The ulcer should at all events be cauterized, and in my practice, as I mentioned before, I have observed cases in which perforation seemed on the point of occurring every moment, and this untoward result was staved off and the ulcer subsequently healed. Should a keratocoele be situated over the iris it may be punctured with good results. I personally prefer to induce healing and incorporate the vesicle rather than produce a synechia anterior. When perforation has taken place the aim must be to create a firm cicatrix. Very small herniæ do not prolapse; larger ones do. If the iris inclines toward the formation of a cystoid mass, it may be cut off on the flat, or according to Leber's method. Adhesions to the cornea may be separated, the contiguous portion off the iris drawn out and snipped off. A coloboma is occasioned thereby and a fistula is likely to result. In the former procedure the iris, in most instances, will continue to prolapse and to form a cyst, and the cornea will become kerectatic. The choice now remains, Shall we apply a pressure bandage and hope, or employ a more drastic procedure with expectations of a successful issue? In these cases iridocyclitis of varying intensity is almost invariably present. If this condition is permitted to persist, the eye will most certainly perish. Should the corneal rarefaction be allowed to progress, the sequelæ of staphyloma, Critchett's operation, and enucleation confront us. Even sympathetic ophthalmia from abscission of the staphylomatous cornea, fol-

lowed by passing sutures through the ciliary body, may be occasioned. Cauterization in most cases produces a firm eschar, assuming that the eye has not entirely disintegrated. Semi-occasionally an enterprising historian reports that the cautery has produced iridocyclitis, forgetting apparently that this condition previously existed. I can readily appreciate the fact that an aggravation of symptoms may be occasioned ; it occurs but infrequently, however ; at any rate, this procedure is the only efficacious one extant. Patients suffering from fistula of the cornea should rest in bed. The edges of the wound may be lightly touched with the cautery, and when the opening is closing, the intra-ocular tension should be kept as normal as possible. A pressure bandage is required. These cases are not very encouraging.

In regard to corneal nebulæ and leucomata, it may be stated in general terms that the larger the opacity, notwithstanding its superficiality, the greater the visual impairment. The rapidity with which cicatrices of the cornea are absorbed in childhood is remarkable. After twenty-one years of age the resorption is almost nil. In order to facilitate their disappearance, gentle massage and vaporization may be advantageously employed. Electricity for this purpose is futile and pernicious. Iridectomies for visual purposes are feasible when a sufficiently clear corneal site remains. Upward colobomata and central scars are trophies of an obsolete method of treating ulcers. I have seen quite a number.

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